Tripoli university
Faculty of engineering
Electrical& electronic department
Course No EE352, summer 2012

Model answer of midterm exam one , date 27/09/ 2012

Duration 2 hours (from 1 pm till 3 :00 pm)

Answer the following questions:-

Question No 1(30 points)

a) **Give explanation of the following symbols and the unit of measuring in SI units:**

ϕ*, B , H , F*

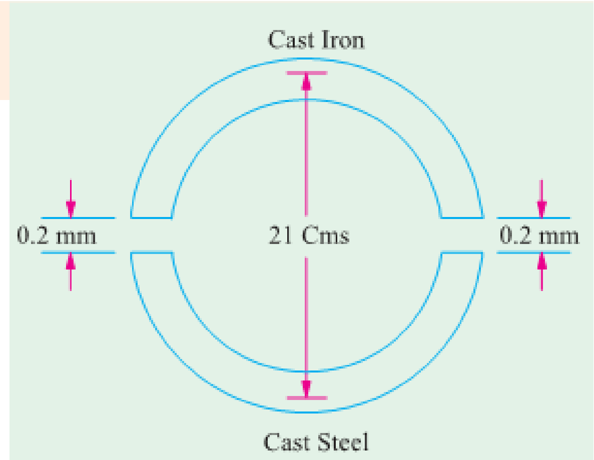
ϕ :- magantic flux measeured by weber (Wb)

B:- **magantic flux density mesured by tesla (A/m^2)**

H:- **magnatic field intansity amper per meter (A/m)**

F:- magnetomotive force measured by amper-turan

b) **A ring has a diameter of 21 cm and a cross-section area of 10 cm2 . The ring is made up of semicircular sections of cast iron and cast steel , with each joint having a reluctance equal to an air –gap of 0.2 mm .**
Find the amper-turn required to produce a flux of 0.8 mWb. Consider the relative permeabilities of cast steel and cast iron are 800 and 166 respectively. (Neglect fringing and leakage effects)



Solutions

$\Phi = 8 \times 10^{-4}$ Wb ; $A = 10 \text{ cm}^2 = 10^{-3} \text{ m}^2$;

$B = 8 \times 10^{-4}/10^{-3} = 0.8 \text{ Wb/m}^2$

Air gap

$H = B/\mu_0 = 0.8/4\pi \times 10^{-7} = 6.366 \times 10^5$ AT/m

Total air-gap length $= 2 \times 0.2 = 0.4$ mm

$= 4 \times 10^{-4}$ m

$\therefore$ AT required $= H \times l = 6.366 \times 10^5 \times 4 \times 10^{-4} = 255$

Cast Steel Path

$H = B/\mu_0 \mu_r = 0.8/4\pi \times 10^{-7} \times 800 = 796$ AT/m

path $= \pi D/2 = 21\ \pi/2 = 33$ cm $= 0.33$ m

AT required $= H \times l = 796 \times 0.33 = 263$

Cast Iron Path

$H = 0.8/\pi \times 10^{-7} \times 166 = 3{,}835$ AT/m ; path $= 0.33$ m

AT required $= 3{,}835 \times 0.33 = 1265$

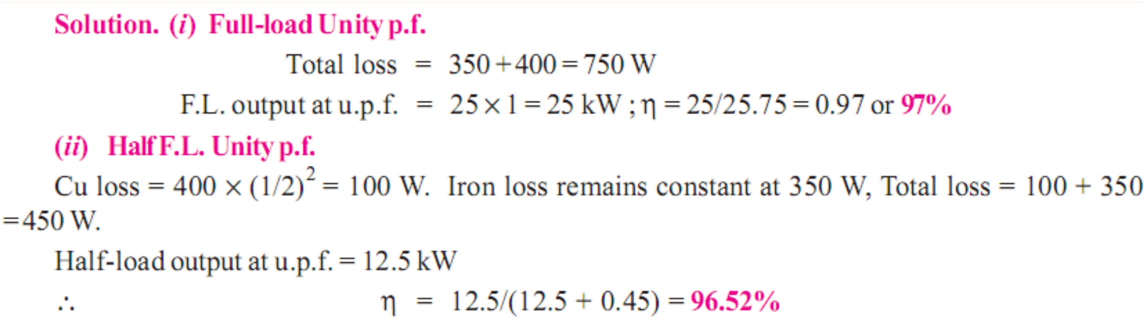
Total AT required $= 255 + 263 + 1265 =$ **1783.**

Question No 2(35 points)

Complete the following statement:-

- By using step up transformer , we increase the voltage and reduce the current, while using step down transformer we increase current and reduce the voltage , but in both cases the power is same.

In a 25-kVA , 2000/200 V , Single –phase transformer , the iron and full-load copper loss are 350 and 400 W respectively . Calculate the efficiency at unity power factor on full load and half full- load.



Solution. (*i*) Full-load Unity p.f.

Total loss = $350 + 400 = 750$ W

F.L. output at u.p.f. = $25 \times 1 = 25$ kW ; $\eta = 25/25.75 = 0.97$ or **97%**

(*ii*) Half F.L. Unity p.f.

Cu loss = $400 \times (1/2)^2 = 100$ W. Iron loss remains constant at 350 W, Total loss = $100 + 350 = 450$ W.

Half-load output at u.p.f. = 12.5 kW

$\therefore \quad \eta = 12.5/(12.5 + 0.45) =$ **96.52%**

Question No 2(35 points)

a

What are the advantage and disadvantage by using autotransformers?

- ***Auto-transformers are more efficient, smaller in size, and cost less than an equivalent two winding transformer of the same rating.***
- ***On the other hand auto-transformers has smaller leakage reactance, and larger fault current can occur as compared to normal two winding transformer of the same rating.***

b)

A 40 – kVA , 3,300/240-V , 50 Hz , 1-pase transformer has 660 turns on the primary . Determine:-

(a) Then number of turns on the secondary.

(b) The maximum value of flux in the core.

(c) The approximate value of primary and secondary full-load currents, internal drop in the winding are to ignored.

Solution:-

$V_1/V_2 = N_1/N_2$ $\quad$ $N_2 = N_1 \times V_2/V_1 = 660 \times 240/3300 = 48$ turns (5)

$E_1 = 4.44\ f\ N_1\ \phi_m$

$\phi_m = E_1/(4.44\ f\ N_1) = 3300/(4.44 * 50 * 660) = 22.52$ m Wb (5)

$S_2 = V_2 * I_2$ $\quad$ $I_2 = S_2/V_2 = 40 * 1000/(240) = 166.7$ A (5)

$S_1 = V_1 * I_1$ $\quad$ $I_1 = S_1/V_1 = 40 * 1000/(3300) = 12.1$ A (5)

Thank you

I. Falah